PUB-NO: EP000173778A1

DOCUMENT-IDENTIFIER: EP 173778 A1

TITLE: Improvements relating to pumps.

PUBN-DATE: March 12, 1986

INVENTOR-INFORMATION:

NAME	COUNTRY
BRISTOW, IAN TREVOR	N/A

ASSIGNEE-INFORMATION:

NAME	COUNTRY
HOBOURN EATON LTD	GB

APPL-NO: EP84306071

APPL-DATE: September 5, 1984

PRIORITY-DATA: EP84306071A (September 5, 1984)

INT-CL (IPC): F04C002/10

EUR-CL (EPC): F04C002/08

US-CL-CURRENT: 418/171

ABSTRACT:

CHG DATE=19990617 STATUS=O> A pump of the N, N+1 type has inner and outer lobed rotors designed to provide at the position of deepest mesh a clearance greater than a working clearance over the whole of the tip region to the lobe (10) of the inner rotor, a working clearance being defined at opposite circumferential sides of the said tip region at positions (18, 19) where tangents to the profile at a selected radial section (21) form a first included angle of 20 DEG or more, e.g. 54 DEG . The flanks (13, 14) of the lobe (10) define at each radial section an included angle which reduces to 20 DEG or less, but in any event less than said first included angle.

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: 0 173 778
A1

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 84306071.6

(22) Date of filing: 05.09.84

(51) Int. Cl.⁴: F 04 C 2/10

(43) Date of publication of application:
12.03.86 Bulletin 86/11

(84) Designated Contracting States:
DE FR GB IT

(71) Applicant: HOBOURN-EATON LIMITED
Priory Road Strood
Rochester, Kent ME2 2BD(GB)

(72) Inventor: Bristow, Ian Trevor
5 Hayes Close
Higham Kent(GB)

(74) Representative: Brooke-Smith, Fred et al,
STEVENS, HEWLETT & PERKINS 5 Quality Court
Chancery Lane
London WC2A 1HZ(GB)

(54) Improvements relating to pumps.

(57) A pump of the N, N+1 type has inner and outer lobed rotors designed to provide at the position of deepest mesh a clearance greater than a working clearance over the whole of the tip region to the lobe (10) of the inner rotor, a working clearance being defined at opposite circumferential sides of the said tip region at positions (18, 19) where tangents to the profile at a selected radial section (21) form a first included angle of 20° or more, e.g. 54°. The flanks (13, 14) of the lobe (10) define at each radial section an included angle which reduces to 20° or less, but in any event less than said first included angle.

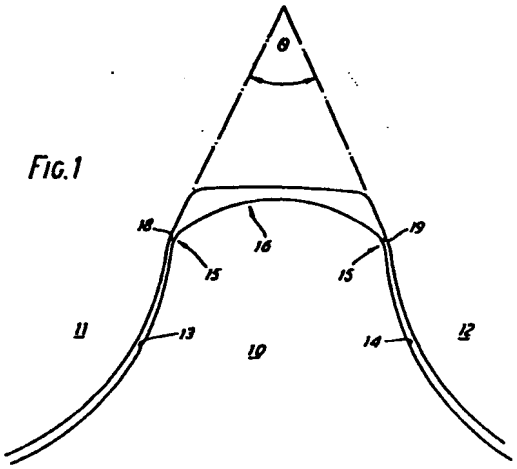

FIG. 1

Croydon Printing Company Ltd

FBS/4674 0173778

IMPROVEMENTS RELATING TO PUMPS

This invention relates to pumps and is more particularly concerned with pumps of the kind variously known as rotor pumps, Eaton pumps or N(N+1) pumps.

According to this invention there is provided a pump comprising an internally lobed annular pump member, and an externally lobed inner pump member disposed within the outer member and arranged to rotate in mesh with the outer member about an axis which is eccentric with respect to that of the outer member, the profile of each lobe of the inner member having two flank portions interconnected by a crown portion, wherein the profiles of the two flanks of each lobe of the inner member define between them at each value of radius from the centre of the inner member an included angle which angle reaches a minimum value of 20^{o} or less and wherein, at the position of full mesh of a lobe of the inner rotor between two lobes of the outer member, the clearance (measured radially from the centre of the inner rotor) between the crown portion of the lobe of the inner member and the co-operating portions of the outer member is greater than a working clearance, a working clearance being provided at two selected locations which are disposed at opposite circumferential ends respectively of the crown portions and which are at a common radius relative to said centre, said locations being where tangents thereto are convergent in a radially outward direction at an angle of 20^{o} or more to each other but greater than the first said included angle.

Some embodiments of the invention will now be described with reference to the accompanying diagrammatic drawings each of which shows the radially outer portions of co-operating lobes of a pump. In the drawings:

Figures 1, 2 and 3 respectively illustrate three forms of pump according to the invention.

The pumps illustrated are of the well-known N, N+1 type comprising in one example, an inner rotor mounted on a drive shaft and having N external lobes, and an outer rotor surrounding the inner rotor formed with N+1 internal lobes with which the external lobes of the inner rotor mesh. The outer rotor is mounted in an external casing for rotation about an axis disposed eccentrically with respect to the axis of the drive shaft and is driven by the inner rotor. This general type of pump is described in more detail in UK Patent Specification No. 596379. In some constructions the form of the lobes may be such as to approximate rather to that of teeth, but for convenience, the term lobes is used herein to include such forms.

Referring now to Figure 1 of the drawing there is illustrated a form of pump with a lobe 10 of the inner rotor fully engaged in the space between two adjoining lobes 11, 12 of the outer rotor.

The rotors are initially in this instance conventionally designed by shaping the outer lobes 11, 12 as arcs of circles interconnected by a cylindrical surface which is centred on the axis of the outer member, and then using the shape of the outer lobes to define the required shape of the inner lobe. The lobe 10 is required to form a seal with the outer

lobes 11 and 12 and at the same time to limit the depth of mesh of the inner and outer rotors, and this militates against employing small included angles in the flank regions of the inner member, because the smaller the included angle, the larger the possible extent of relative movement of the members in the radial direction for a given circumferential clearance. In known pumps the angle θ commonly has a minimum value of 30^{o} or more, but it is advantageous to use smaller included angles on the flanks of the inner rotor for the purpose of improved efficiency of operation.

In applying the present invention, the two convergent flank curves 13, 14 of the lobe 10 define at each radial section an included angle θ and this angle decreases progressively to a minimum value of 12^{o} and then increases sharply with increasing radius in the region indicated at 15 near the maximum radius of the inner rotor. Also, the profile of the outer member is modified in two respects. Firstly the profile is modified to form a radial clearance well in excess of the working clearance is left in the crown or tip regions 16 of the lobe 10 to provide a relatively large volume about the tip region of the lobe and thereby to reduce the noise level of the pump in operation. Secondly, at a radial section of the inner member where the included angle is in excess of 20^{o}, the profile of the outer rotor is modified at opposite circumferential ends of the crown region to form two locations 18, 19 respectively at which the radial clearance between lobe 10 and lobes 11 and 12 is a working minimum so that the maximum relative radial movement of the two members is determined by the

clearance at these two locations and is such as to provide a correct seal between the members at the diametrically opposite side of the two members. The peripheral extent of the two locations 18, 19 can be selected as desired but between these two locations the clearance between the two members is in excess of a working clearance.

In one form of the pump the included angle at the locations 18, 19 is 90^{o}.

In constructions according to the invention a minimum value of the included angle θ in the flank regions 13, 14 of the inner member of 20^{o} or less is employed (e.g. the flanks may be parallel to each other over part of their length and provides improved volumetric efficiency and improved driving efficiency while retaining the advantages of the large clearance in the tip region of the lobe 10.

In effect the working clearance is set at two locations at opposite circumferential ends of the tip region respectively.

Figure 2 shows an application of the invention to a pump in which each lobe 22 of the inner rotor is asymmetrical about a radial line through the tip of the lobe. In this case the outer rotor has lobes 23, 24 and the rotary drive is transmitted between the flank 25 of lobe 22 and the co-operating flank 26 of lobe 23. At a radial section 21 at which the included angle θ reaches a value 20^{o} or more (54^{o} in this instance), the shape of the flank 26 is modified to provide a location 28 at which the clearance between the two rotors (measured in a direction parallel to a radial line through the mid-point between location 28

and the corresponding point 30 on the other flank 29) has a value such as to constitute a working clearance. The engagement of location 28 and point 30 with the respective co-operating locations on the lobes 23, 24 produces a wedge-like action which serves to provide an effective limit on the depth of mesh of lobe 22 between the lobes 23, 24. As before, the clearance between the crown or tip region of lobe 22 and the co-operating portions of the outer rotor is substantially in excess of the normal working clearance.

Referring now to Figure 3, there is illustrated a way in which the invention can be applied to a pump of the N(N+1) type in which the lobes 30 of the inner rotor are waisted, the lobes 31a, 31b of the outer rotor being of appropriately modified profile. The full lines 33, 34 show the modified profile of the outer rotor employed as a result of the application of the present invention, and the chain lines 35 indicate the modified portions of the profile. At locations 36, 37 on a radial section 38 on the inner rotor, where the included angle θ has a value of 20^{o} or more, the profile of the co-operating surface portions of the outer rotor is modified to reduce the clearance between the members (measured in directions parallel to the radial centre line of the lobe 30) to a value which is the lowest over the whole periphery of the lobe and which determines the maximum radial depth of mesh of lobe 30 between lobes 31a and 31b. Over the whole of the crown region between locations 36 and 37 the radial clearance between the rotors is well in excess of a working clearance.

It will be understood that where the inner rotor has an odd number of lobes, the seal at the diametrically opposite side of the member will be formed by

each of two lobes flanking opposite sides of the diameter engaging co-operating lobes of the outer rotor by portions which are offset from the axis of symmetry of the lobes, and it is therefore desirable to ensure that the portions of the inner lobes which form these seals are out of contact with the outer rotor at the point of full mesh, so as to avoid unnecessary wear on these portions.

Thus, a large clearance is provided over the whole of the tip region, and the working clearance is set at two shoulder locations at opposite ends respectively of the tip region. In some cases, the modification of the profile of the outer rotor at the locations where the clearance is a minimum as described in the foregoing may be such as to form a step-like formation at such locations.

CLAIMS

1. A pump comprising an internally lobed annular pump member, and an externally lobed inner pump member disposed within the outer member and arranged to rotate in mesh with the outer member about an axis which is eccentric with respect to that of the outer member, the profile of each lobe of the inner member having two flank portions interconnected by a crown portion, wherein the profiles of the two flanks of each lobe of the inner member define between them at each value of radius from the centre of the inner member an inckuded angle which angle reaches a minimum value of 20^{o} or less and wherein, at the position of full mesh of a lobe of the inner rotor between two lobes of the outer member, the clearance (measured radially from the centre of the inner rotor) between the crown portion of the lobe of the inner member and the co-operating portions of the outer member is greater than a working clearance, a working clearance being provided at two selected locations which are disposed at opposite circumferential ends respectively of the crown portions and which are at a common radius relative to said centre, said locations being where tangents thereto are convergent in a radially outward direction at an angle of 20^{o} or more to each other but greater than the first said included angle.

2. A pump as claimed in claim 1, wherein said tangents converge at an angle in excess of 30^{o}.

3. A pump as claimed in claim 1, wherein said tangents converge at an angle in excess of 40^{o}.

4. A pump as claimed in claim 1, wherein said tangents converge at an angle in excess of 50^{o}.

6. A pump as claimed in any one of the preceding claims, wherein said working clearances at said two locations are achieved by modifying the profiles of the flanks of the lobes of the outer member.

7. A pump as claimed in any one of the preceding claims, wherein the lobes of the inner member are waisted radially inward of said common radius.

8. A pump as claimed in any one of the preceding claims, wherein the crown portion of each of the lobes of the inner member is asymmetric about a radial line extending through the tip of the lobe.

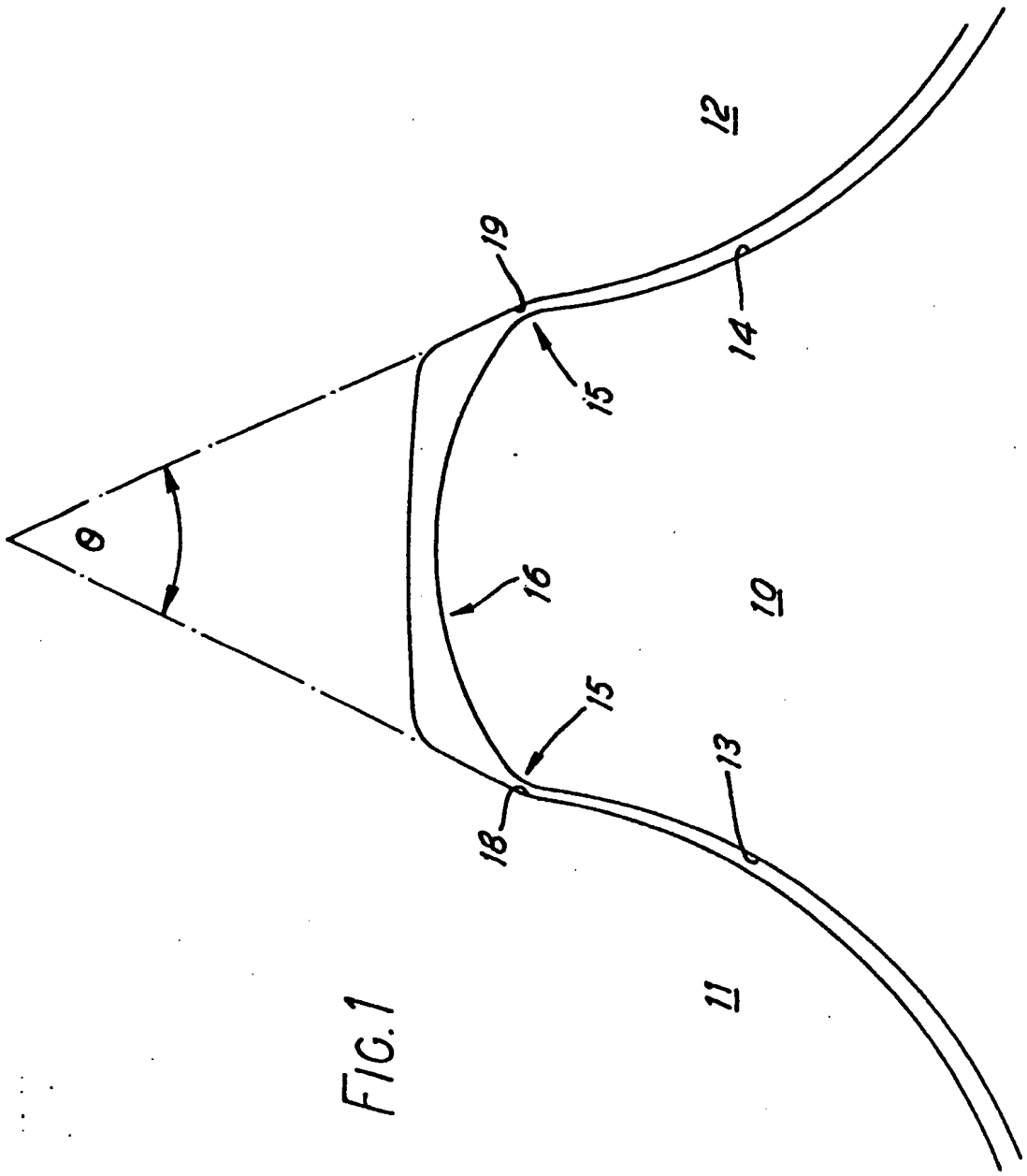

FIG. 1

0173778

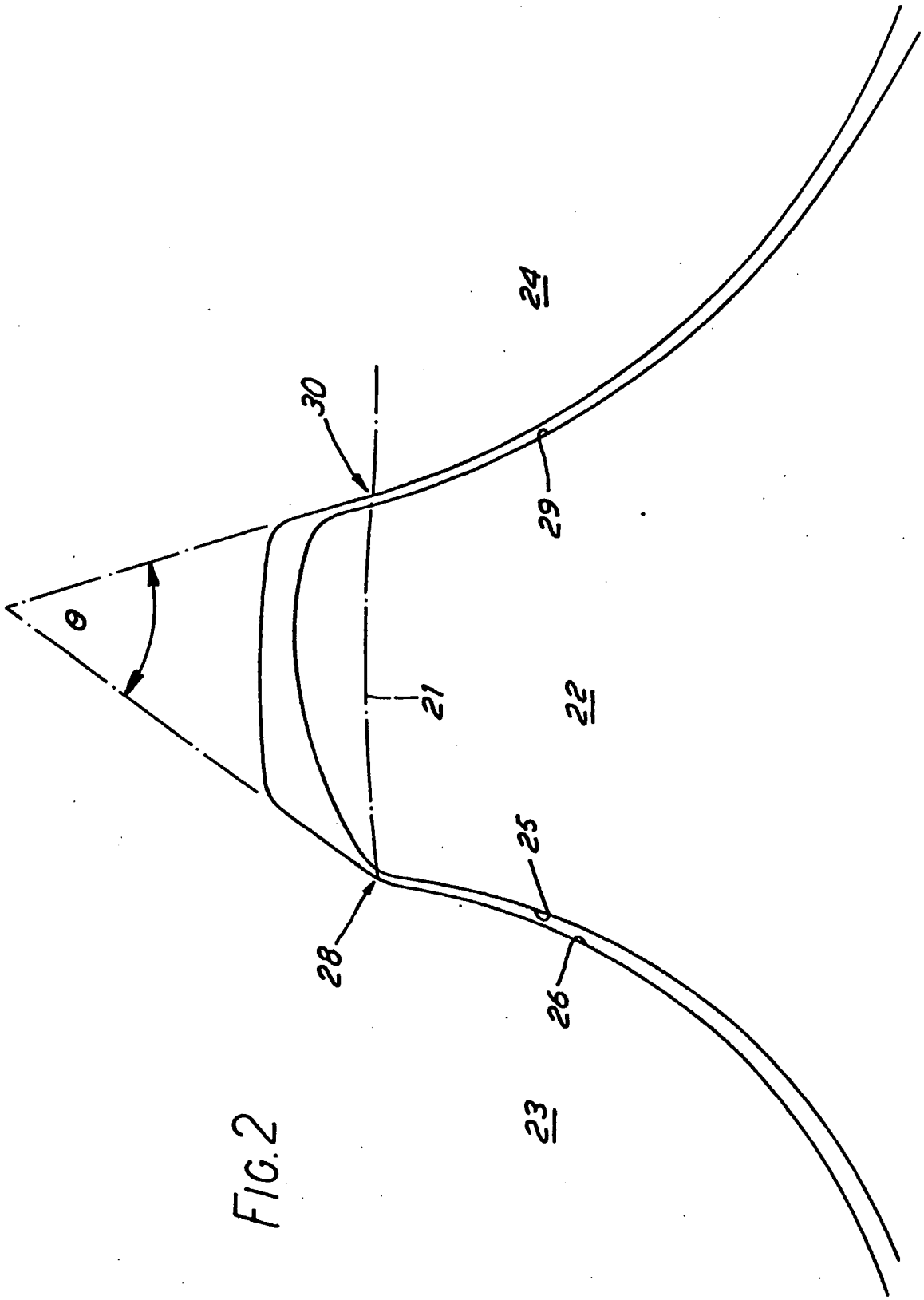

FIG.2

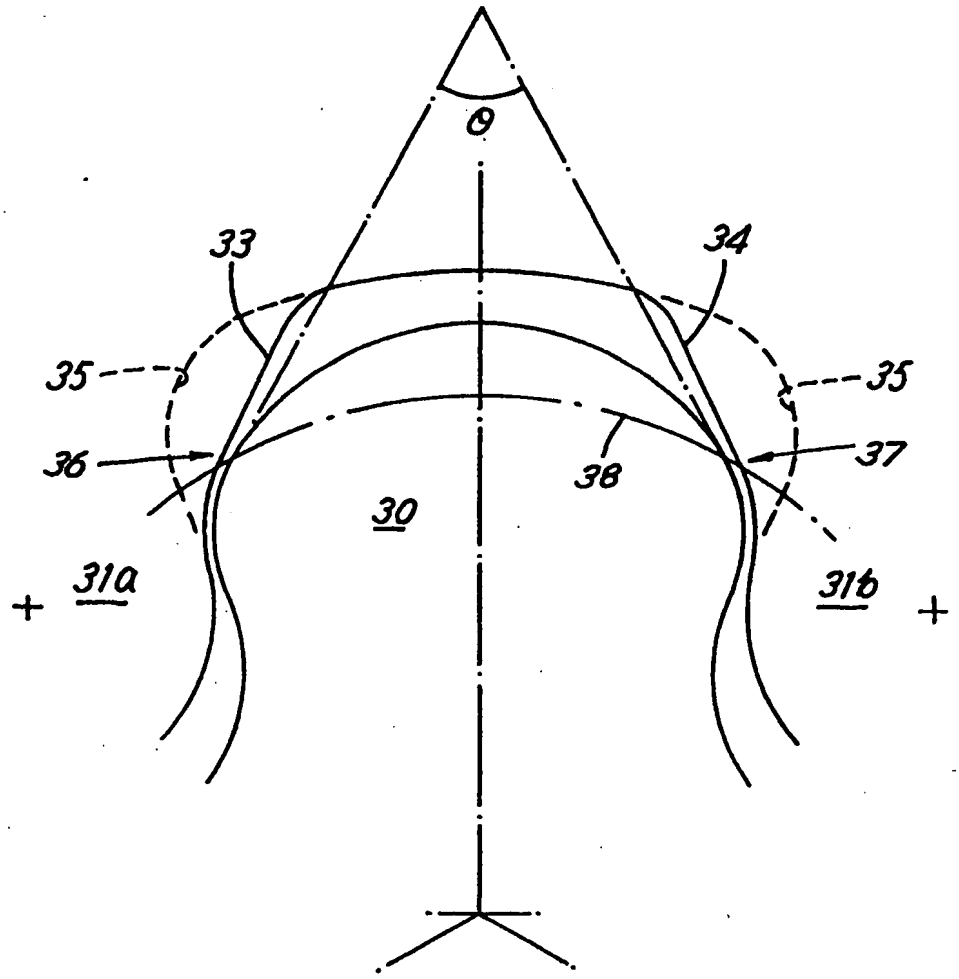

FIG. 3

European Patent Office

EUROPEAN SEARCH REPORT

0178178

Application Number

EP 84 30 6071

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl 4)
A	EP-A-0 072 636 (CONCENTRIC PUMPS) * Page 2, lines 6-15; page 6, line 6 - page 7, line 9; figure 3 *	1-4	F 04 C 2/10
A	GB-A-2 085 969 (HOBOURN-EATON) * Abstract *	8	
A	FR-A-1 251 504 (BORG-WARNER) * Page 8, left-hand column, lines 11-24, figure 7 and right-hand column, lines 3-16; figure 8 *	5	

TECHNICAL FIELDS SEARCHED (Int. Cl 4)

F 04 C
F 01 C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	07-05-1985	KAPOULAS T.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503. 03 82